

## ANSWERS: Combination

1) Combination reactions which both require heat to occur.

A grey strip of metal when heated in air, bursts into a bright white flame, producing a white powdery residue.

The grey strip of metal is magnesium, which reacts with oxygen in the air. The powdery white substance formed is magnesium oxide.

Zinc sulfide, ZnS.

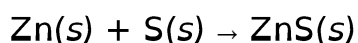
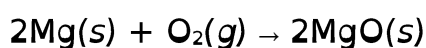
The grey powder is zinc powder, which reacts with the yellow powdered sulfur to form white zinc sulfide.

Each reactant, Mg, O<sub>2</sub>, Zn, and S is less stable as atoms than they are as ions.

To become stable, metal atoms empty their valence electron shells by losing electrons to non-metal atoms, which gain electrons to fill their valence electron shell.

When Mg reacts with O<sub>2</sub>, each Mg atom loses 2 electrons to form Mg<sup>2+</sup>, which is more stable than Mg. Each O atom gains 2 electrons to form O<sup>2-</sup>, which is more stable than the elemental O<sub>2</sub>. Together they form MgO.

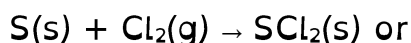
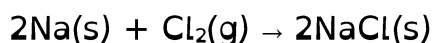
Similarly, Zn atoms lose 2 electrons each to S atoms, resulting in stable Zn<sup>2+</sup> and S<sup>2-</sup> ions forming ZnS.



2) Shiny grey metal sodium reacts with yellow / green chlorine gas to form white crystals of sodium chloride.

Sulfur dichloride or disulfur dichloride or sulfur chloride.

This is a combination reaction because two elements, sulfur and chlorine combine to form a new substance / compound, (di)sulfur dichloride.



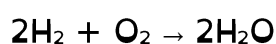
Sodium is a metal element and when it reacts with chlorine gas, both elements form ions. Each sodium atom loses 1 electron to each chlorine atom / each chlorine atom gains 1 electron. Sodium ions and chloride ions combine to form the (ionic) compound sodium chloride, NaCl.

Sulfur is a non-metal element and when it reacts with chlorine gas, electrons are shared. Sulfur and chlorine atoms combine to form the (covalent) compound sulfur dichloride,  $\text{SCl}_2$ .

3) This is an example of a combination (accept combustion or oxidation) reaction because two elements react together to form one new compound.

The hydrogen and oxygen would explode with a small flame and a loud squeaky pop would be heard. Condensation / colourless (*not clear*) liquid (water) would form on the tube.

Condensation forming in the tube could be tested with  $\text{CoCl}_2$  paper, which will turn from blue to pink.



4) At room temperature, iron and sulfur can be mixed in a beaker as a mixture. Heat is required for the reaction to occur.

**Iron:**

Physical: solid, black / grey, magnetic, metallic properties.

Chemical: 2 electrons to lose so it is relatively reactive.

**Sulfur:**

Physical: yellow solid, brittle, non metallic properties.

Chemical: reactive due to requiring 2 valence electrons for a stable octet.

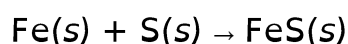
**Iron sulfide:**

Physical: black solid, no longer magnetic.

Chemical: a stable ionic compound.

In the reaction, there is a **glow** as the sulfur melts and reacts with the iron.

Each Fe atom loses 2 electrons forming  $\text{Fe}^{2+}$ , each sulfur atom gains 2 electrons,  $\text{S}^{2-}$



5) Conditions required:

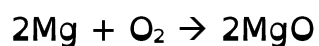
Both reactions would require the solid to be heated in air or oxygen before the solid reacts.

Observations:

When the grey magnesium metal, is heated in air till it ignites, it burns with an intense white flame, producing white smoke and ash. When the black carbon solid

is heated in air till it ignites, it burns with a yellow flame, producing a colourless gas.

Combination reactions:



Similarities:

Both elements react with oxygen combining with another element. Both elements have to be heated to react with oxygen.

Differences:

The reaction of magnesium with oxygen produced a white ash /solid. Magnesium burns with a bright white flame. The reaction of carbon with oxygen produced a colourless gas. Carbon burns with a yellow /orange flame.